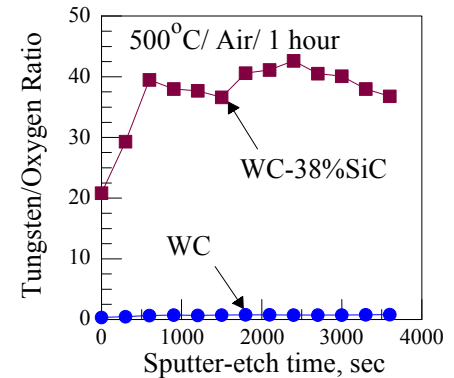
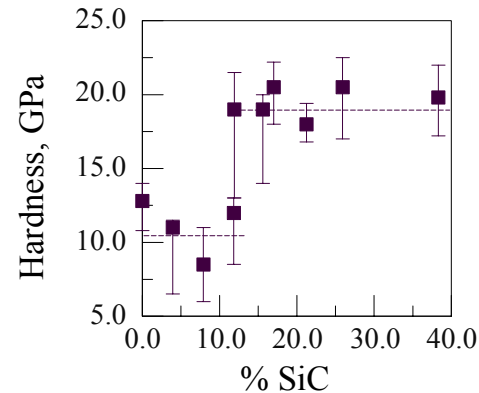


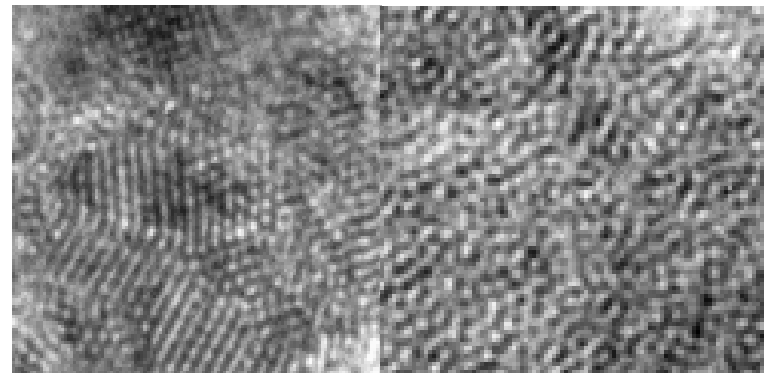
Property Enhancement and Structural Disordering in WC Films Induced by SiC Additions

James E. Krzanowski, University of New Hampshire, DMR-0207522

Carbides are materials that possess excellent strength, hardness, and thermal stability. The use of transition metal carbides as thin film coatings is attractive for applications such as wear-resistant hard coatings and diffusion barriers in integrated circuits. However, the properties of carbides in the form of deposited thin films often fall short of bulk properties. Furthermore, the inadequate oxidation resistance of carbides limits some applications. We have discovered that alloying transition metal carbides with silicon carbide in sputter-deposited thin films can significantly enhance properties. For example, the figure at upper left shows the hardness of tungsten carbide films increases from near 12 to 20 GPa at 12% silicon carbide; the XPS results (upper right) show reduced oxidation after 500°C air exposure in a film with 38% silicon carbide. High-resolution electron microscopy studies show that the silicon carbide induces structural disordering, as shown in the lower two figures.



Left, hardness enhancement due to SiC additions; right, improved oxidation resistance demonstrated



Atomic-level images of: left, crystalline WC; right, disordered structure induced by Si in a 25% SiC film

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Education:

Two undergraduates (William Porter and Chris Cobb) and one graduate student (Jonathan Wormwood) are currently working on projects related to this research. William Porter is conducting oxidation and thermal stability studies of WC-SiC films. Chris Cobb is will study the mechanical and tribological properties of WC/C/SiC films deposited by pulsed laser deposition. Jonathan Wormwood is conducting his M.S. thesis research on the property enhancements and structural disordering in transition metal carbide/silicon carbide thin films.

Outreach:

We are currently working with Pinkerton Academy, an independent academy located in Derry, NH serving 3,250 students in high school grades 9 – 12. Our program provides research experiences for students who excel in the high school science program. We currently have four students involved in this program.



High school students learn about the applications of an SEM in Materials Science research